KOGRUKLUK WEIR SALMON ESCAPEMENT REPORT

1990

By

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ABSTRACT

The Kogrukluk Weir project provides the most reliable chinook, sockeye, coho and chum salmon escapement data in the mid- and upper-Kuskokwim River drainage. Data have been collected since 1976. The weir was operated in 1990 from 28 June to 9 September. Historic timing data was used to estimate missing data to derive total season estimated salmon escapements of 10,218 chinook, 8,406 sockeye, 6,132 coho and 26,750 chum. The dominant age classes from age, length and sex (ALS) samples were ages 1.3, 1.3, 2.1, and 0.3 for chinook, sockeye, coho, and chum salmon. ALS sample sex ratios were 0.19:1 (n=367), 0.30:1 (n=154), 0.15:1 (n=173), and 0.22:1 (n=382) for chinook, sockeye, coho, and chum salmon. During the operating period 684 chinook, 556 sockeye, 3 pink, and 6,004 chum salmon carcasses were removed from the weir.

INTRODUCTION

Description of Area

The Kogrukluk Weir project is located in the remote upper reaches of the Holitna River, a major tributary to the Kuskokwim River. The Holitna River headwater is formed at the confluence of the Kogrukluk and Chukowan Rivers about one mile above the village of Kashegelok in the central Kuskokwim River drainage (Figure 1) in western Alaska.

The Kogrukluk River is formed by surface runoff from the north side of the plateau dividing the Tikchik Lakes and Nushagak River system from the Kuskokwim River system and from numerous streams which originate in the Shotgun Hills to the east. From a point about five miles from Nishlik Lake, the uppermost lake of the Tikchiks, the Kogrukluk River flows northerly for about 43 miles before it joins the Chukowan River. Shotgun Creek, a major tributary, joins the Kogrukluk about two miles upstream from the Chukowan confluence where the Holitna River begins (Figure 2).

Salmon Resources

The waters of the Kuskokwim River drainage produce six species of North American Pacific salmon (*Oncorhynchus* spp.). The species of primary commercial and subsistence importance in the region are chinook (*O. tshawytscha*), chum (*O. keta*), and coho salmon (*O. kisutch*). The traditional native subsistence fishery in the Kuskokwim area may account for as much as a third of the chum salmon harvest and half or more of the chinook salmon harvest in any year. Coho salmon have not been traditionally important in the local subsistence economy. The sport fishery in the Kuskokwim area is undeveloped, and the commercial fishery is primarily accountable for the remainder of the harvest of chinook and chum salmon. The Kuskokwim commercial coho salmon fishery is in its late development stage, and the stock has proven to be capable of sustaining substantial and economically important harvest levels since about 1978. Pink salmon (*O. gorbuscha*) are economically unimportant in the Kuskokwim area.

The Kogrukluk River is a major salmon producer in the Holitna drainage. The river is capable of significant production of chinook, chum, and coho salmon. In some years relatively large numbers of sockeye salmon (*O. nerka*) may be produced. The relative abundance of pink salmon is unknown in the Kogrukluk River, but adults are observed passing through the weir in most years.

Management Needs

The abundant quantities of economically valuable Pacific salmon which are produced in the Kuskokwim River drainage require monitoring by professional fisheries resource managers in order to optimize natural reproduction and allowable harvest. Subsistence and commercial fishermen who live along the Kuskokwim River place major cultural and economic importance upon harvests of chum and chinook salmon. The population of the Kuskokwim area is rapidly expanding. The resulting increase of pressure on the salmon resource to provide cash and subsistence food and to maintain the accustomed lifestyle of the native people is accompanied by growing interest in more efficient harvest techniques and equipment. In other fisheries, this combination has proven to be a forewarning of resource over-exploitation resulting in depletion of fish stock abundance.

Obtaining salmon escapement data from Kuskokwim River tributaries is necessary for the evaluation of the effectiveness of regulatory actions taken in the fishery. Currently there are two salmon escapement monitoring projects in the Kuskokwim drainage: the Aniak Sonar project which is designed to provide inseason chum salmon escapement data and the Kogrukluk Weir project which provides escapement data for all indigenous salmon species except pink salmon. Additionally, a main river sonar project located on the Kuskokwim River slightly upstream of Bethel is in the late development phase and is expected to provide more comprehensive estimates of Kuskokwim drainage salmon escapements in the near future.

The Holitna River is an important source of production of Kuskokwim chinook, chum and coho salmon. Recorded evidence of this has accumulated since 1961 (Schneiderhan 1983) when the earliest aerial survey of the Holitna River was documented. The apparent importance of the Holitna River as a salmon producer and the necessity to more closely monitor escapements of spawning salmon led to a series of attempts to establish a permanent salmon escapement monitoring project in the Holitna drainage. The Kogrukluk Weir project is the result of those attempts.

Effective harvest regulation depends on stock assessment. Test fishing near Bethel provides a good index of total returns and escapement for the drainage, but is incapable of discriminating among the stocks of salmon which spawn in various portions of the drainage. These stocks are extremely important to Kuskokwim River subsistence users, and their proper conservation is necessary for continuation as a viable, renewable resource capable of supporting new and traditional economies.

Accurate escapement data reduces the risk of adversely impacting local economies through overly conservative management practices. People in the Kuskokwim area are increasingly perceptive of the need for more and better information about upriver salmon stocks and have greater confidence in management decisions which are supported by reliable data. Annual assessment of the Kogrukluk River salmon escapements has become an important priority in the Department salmon management and research programs.

Project History

The need for accurate assessment of salmon escapements in the mid-and upper-Kuskokwim drainage stimulated the development of a salmon counting tower on the Kogrukluk River in 1971. The tower was located slightly more than a mile above the confluence of Shotgun Creek.

Inadequacies of the tower site and the absence of a more suitable nearby tower site resulted in the changeover between 1976 and 1978 from a tower counting project to a weir counting project. The weir was located downstream from the confluence of Shotgun Creek and about a mile upstream of the confluence of the Chukowan River.

From 1976 to 1978, the tower and weir were both operated to gather data for relating the results of the two projects. During that time, only the 1978 operations provided an acceptable set of data from each project.

During the early years of the project, coho salmon escapements were not monitored. Beginning in 1981 the weir was operated from June to October and coho as well as chinook, sockeye, and chum salmon data was obtained.

Objectives

The following objectives have been established for the Kogrukluk Weir project:

1. Provide daily counts of the spawning escapement of chinook, sockeye, coho, and chum salmon by sex.

2. Describe the migratory timing of chinook, sockeye, coho and chum salmon spawning escapements.

3. Describe the age, sex and size composition of the chinook, sockeye, coho and chum salmon spawning escapements.

4. Index gill net fishing intensity by comparing the frequency of gill net marked salmon at the weir with prior years.

5. Estimate carcass wash out rate and timing by species.

6. Monitor variability in stream hydrologic conditions and atmospheric conditions to provide information relating to potential environmental effects on salmon production.

METHODS

Weir Construction and Maintenance

The weir consisted of black iron pipe pickets held in position by angle iron stringers, ten feet in length, which had been perforated on one side to receive about 45 pickets (3/4" black iron pipe). The stringers were overlapped and braced by "A" shaped steel pipe support pods at each ten foot juncture to span the 230 foot wide river. The triangular "A" pods were constructed of 1- 1/2" black iron pipe (schedule 80) and Kee Klamps (TM). The trap was constructed of picket pipes and stringers to dimensions of 6' x 10' x 4' deep. It had a funnel shaped entrance and was placed just upstream of an opening in the weir (Figure 3). All salmon except pink had to pass through the trap before proceeding up-stream. Other details of weir construction may be found in *Ignatti Weir Construction Manual* (Baxter 1981).

Salmon Counts

Salmon were enumerated from an observation position on top of the trap. Two to four pickets were pulled out of the side of one upstream corner of the trap to allow salmon to pass. Visibility and definition were enhanced by yellow plywood flasher panels placed on the stream bottom at the exit to the trap. Twelve data categories were tallied on tally counters mounted on a pedestal near the counting position. Categories were the numbers of 1) male chinook, 2) female chinook, 3) male chum, 4) female chum, 5) male sockeye, 6) female sockeye, 7) gill net marked male chinook, 8) gill net marked female chinook, 9) gill net marked male chum, 10) gill net marked female chum, 11) gill net marked male sockeye, and 12) gill net marked female sockeye salmon. During the coho migration, the above data was maintained for the few remaining chinook, sockeye, and chum migrants; however, the primary thrust of the ensuing period was to obtain numbers of 1) male coho, 2) female coho, 3) gill net marked male coho, and 4) gill net marked female coho.

Except between 2400 and 0730 hours, the weir trap was cleared of salmon once or more every 6 hours throughout the day and night. From 2400 to 0730 hours, the trap exit is closed; however, upstream migration of salmon during that time is usually very slow and it is unnecessary to allow passage through the weir. At 0730 hours all salmon in the trap are allowed to proceed upstream and are counted at that time.

Count data was entered in a field notebook at the end of each six hour period. The following data was recorded: date, six-hour period (1,2,3 or 4), species, sex, count, and number with gill net marks.

Migration Timing Database

At the conclusion of the 1988 field season, the historic salmon count data was subjectively expanded for some years in order to produce a migration timing database with as many years represented as possible. Chinook, sockeye, coho, and chum salmon counts were examined. After the subjective expansion was performed, the migration timing database consisted of nine years of data for chinook, sockeye, and chum salmon (1976, 1978, 1979, 1981, 1982, 1984, 1985, 1986, and 1988) and eight years of data for coho salmon (1981-1988). From that data three time series models were produced which represented weir passage timing scenarios for early, normal and late migrations (Schneiderhan 1989).

Age, Length and Sex Samples

General sample size objectives were 150 samples per species for each time strata. Sample size objectives for chinook and chum salmon provide for three time strata while one sample strata for sockeye salmon was to be collected. Sample goals for coho salmon called for four time strata to be collected. The specific objectives for the 1990 season were defined as follows:

Weir start-up to 18 July:
- 20 chinook per day
- 10 sockeye per day
- 20 chum per day

19 July to 23 July:
- 15 chinook per day
- 10 sockeye per day
- 15 chum per day

24 July to 14 August:
- no sampling

15 August to 22 August:
- 15 coho per day

23 August to 10 September:
- 20 coho per day

11 September to 22 September:
- 15 coho per day

Scale samples, sex and lengths were taken from salmon which were dipped from the trap while it was closed. Sampling generally took place between 0900 and 1500 hours daily. The scales were aged after the season to determine the sample age composition of each species.

Length and sex was recorded and scales collected and mounted on gummed scale cards. Mideye to fork of tail length (mm) was measured and a scale (three from chinook and coho) from the preferred area (Statewide Stock Biology Group 1984) on the left side of the fish was taken. The salmon was then carefully released on the upstream side of the weir.

Salmon Carcass Counts

Salmon carcasses which washed down the river and were stopped by the weir were counted by species when the weir was cleaned. The weir was cleaned at least once per day.

Data Analysis

Cumulative counts to date and daily inseason estimates of total escapement were calculated daily in the Bethel Fish and Game office. The counts were entered into a Lotus 1-2-3 (TM) worksheet which calculated the two numbers. In a normal year, daily cumulative proportions by species or species and sex, and mean date (Mundy 1982) of migration by species or species and sex were calculated. Scale samples were pressed in acetate and analyzed by the project biologist at the end of the season. Completed OPSCAN forms containing age, sex and length data were processed through the OPSCAN reader in the Anchorage office at the conclusion of the field season. Custom programs written by Conrad (1985) were used for the initial analysis of age, sex and length data in OPSCAN output format.

Region wide standards have been set for the sample size needed to describe the age composition of a salmon population. These were applied to the time period or stratum in which the sample was collected. Sample size goals of 150 randomly selected samples in each time strata were chosen to estimate age composition based on a one-in-twenty chance (95% precision) of not having the true age proportion (p_i) within the interval $p_i \pm .10$ for all i ages (the accuracy of the sample).

Brood year weir returns per spawner tables were updated using each year's age composition and escapement data as it became available.

Meteorologic and Hydrologic Factors

Meteorologic and hydrologic factors were measured at noon (1200 hours) each day. Maximum air temperature was measured on the max-min recording thermometer for the preceding day. Minimum air temperature was for the current day. Water temperature was measured with a pocket mercury or alcohol thermometer calibrated in either Fahrenheit or Celsius. Precipitation for the prior 24 hour period was measured using a standard precipitation gauge (10 to 1 ratio). The amount of cloud cover and wind direction and velocity was estimated by the observer.

RESULTS

Salmon Counts

The weir was operated continuously from 1600 hours on 28 June to 1800 hours on 9 September. Actual weir counts during the operational period in 1990 were 10,093 chinook, 8,383 sockeye, 2,736 coho, and 26,555 chum salmon (Table 1). The operation spanned the normal mean dates of weir passage for chinook, sockeye and chum salmon (10-13 July). The chinook, sockeye, and chum salmon data was augmented with estimates of daily passage for the periods 15 June to 27 June (Table 2). The models used for chinook and sockeye salmon were the normal daily proportion series of historical data (Schneiderhan 1989). Migration timing for coho and chum salmon appeared to be later than normal for those species. The late timing of the chum and coho salmon migrations may have been caused by extremely low water levels at the weir site in July and August (Figure 4).

The estimated total season chinook escapement (10,218) was 102 percent of the escapement objective (10,000) for the Kogrukluk River (Table 3). The estimated sockeye escapement (8,406) was 420 percent of the objective (2,000). The estimated chum escapement (26,750) was 89 percent of the escapement objective (30,000). The estimated coho escapement (6,132) was 25 percent of the objective (25,000).

' total of 684 chinook, 556 sockeye, 3 pink, and 6,004 chum salmon carcasses were ınted during the operating periods. No coho carcasses were encountered during ..ıe project operation (Table 4).

Age, Length and Sex Composition

Chinook

Age, length and sex (ALS) data was obtained from 367 live specimens. The age class composition was age 1.1 (3%), age 1.2 (27%), age 1.3 (60%), age 1.4 (11%), and age 1.5 (>1%). The mean lengths were 572.4 mm, 583.0 mm, 746.0 mm, 861.1 mm, and 852.0 mm for ages 1.1, 1.2, 1.3, 1.4, and 1.5, respectively. The female to male sex ratios were 0:1, 0:1, 0.23:1, 2.55:1, and 1:0 for the respective age classes (Table 5). The sex ratio for the sample was 0.24:1 (19% female).

Sockeye

ALS data was obtained from 154 live specimens. Age classes included age 0.3 (1%), 0.4 (1%), 1.3 (92%) and age 1.4 (6%). The mean lengths were 526.0 mm, 608.0 mm, 567.7 mm, and 581.6 mm for the respective age classes. The female to male sex ratios were 1:1, 0:1, 0.39:1, and 1.25:1, respectively (Table 6). The sex ratio for the sample was approximately 0.43:1 (30% female).

Coho

ALS data was obtained from 173 live specimens. The dominant age class was age 2.1 (84%). 11 specimens (6%) was age 1.1 and 16 fish (9%) were age 3.1. The mean length of the dominant age class was 560 mm. The female to male sex ratio was 0.14:1 for the dominant age class (Table 7). The sex ratio for the sample was 0.15:1 (13% female).

Chum

ALS data was obtained from 382 live specimens. The dominant age classes were 0.3 (73%) and 0.4 (26%). Four specimens were age 0.5. The mean lengths were 578.1 mm and 605.1 mm for the respective dominant age classes. The female to male sex ratios were 0.30:1 and 0.25:1, respectively, for the dominant age classes (Table 8). The sex ratio for the sample was 0.28:1 (22% female).

Weir-based Brood Year Returns

Chinook

Spawner escapement estimates were apportioned by age class for each year (Table 9). The results were used to calculate the estimated returns above the weir per spawner above the weir. Estimates of catch allocated to the Kogrukluk stock are not available due to the lack of stock identification data, therefore they were not included in the calculation of weir return per spawner. Chinook salmon weir returns per spawner were well above simple replacement levels (1.0 return per spawner) for most brood years from 1972 to 1977 (no data for 1974). The 1978 to 1983 brood year weir returns per spawner have ranged from 0.30 to 0.58, well below the replacement level, while 1983 weir returns per spawner are well over the simple replacement level at 4.58 (Appendix A.1).

Sockeye

Sockeye salmon spawner escapements were apportioned by age class (Table 10). Sockeye salmon weir returns per spawner were well above the replacement level in all but one brood year from 1976 to 1980. The 1981 and 1982 brood year weir returns were very weak. They were followed by the very strong 1983 and strong 1984 and 1985 brood year weir returns (Appendix A.2).

Chum

Chum salmon spawner escapement estimates were apportioned by age class for each year (Table 11). Weir returns per spawner were well above replacement for the 1976 brood year. The 1977 to 1980 brood year weir returns per spawner ranged slightly above replacement (1.07 to 2.12). Very weak returns per spawner for the 1981 and 1982 brood years (0.19 and 0.30) were followed by strong returns of 1.85 and 1.43 in the 1983 and 1984 brood years (Appendix A.3).

Gill Net Marked Salmon

Gill net mark data similar to that presented in this report was recorded in all years of successful project operation; however, only limited attempts have been made to analyze it, and those provided inconclusive results. The relative frequency of gill net marks in 1990 appeared typical of other years. Gill net marks were relatively common on chinook and chum salmon and relatively uncommon on sockeye and coho salmon (Table 12).

Meteorologic and Hydrologic Factors

Meteorologic and hydrologic factors during the operating period are listed in Table 13. This type of data has been recorded each year since the project was initiated in 1976. No attempt has been made to relate meteorologic or hydrologic factors to fish production. Extremely low water levels were observed in July and August (Figure 4) due to lack of significant precipitation (Figure 4)

DISCUSSION

Management Applications

Management of the commercial salmon fisheries on the lower Kuskokwim River is more responsive to spawning ground escapement levels because of inseason projection techniques which accept cumulative escapement estimates as input. Prior to 1984, relative escapement success was not known until after aerial assessments were completed, often as late as early August. The chinook, sockeye and chum salmon commercial fisheries are usually concluded by 15 July. Using the estimates provided by daily weir data often enables fair projections of escapements beginning around 5 July. The quality of the projections improves as daily counts accumulate.

As a general rule, the most reliable early projections are obtained when the weir operation begins on or before 1 July. The preferred start up date is 25 June. That allows for documentation of earlier than anticipated migration passage. When operation is not possible until after 1 July, escapement projections using the initially available data are less reliable, because the first component of migration passage is missing from the cumulative total. After sufficient data is available, estimates can be made of the incomplete early data. The cumulative totals can then be adjusted, and more dependable inseason escapement projections can be computed.

Migration Timing Database

The migration timing data consists of daily and daily cumulative proportions of estimated weir counts of each species for all years of sufficient operational duration. These data are used to estimate portions of a current migration count which may be missed when the weir is not operating effectively. It is also the basis for inseason estimates of final total season abundance.

Currently, the migration timing database consists of usable data through 1988 (nine years for chinook, sockeye and chum and eight years for coho excluding unusable data). The essential products of the database are the migration timing models for each species. The models were applied to 1990 counts to provide the final escapement estimates reported in the results section.

Annual Escapements

Chinook

The escapement objective of 10,000 chinook was established in 1983. Based on available data at that time, it was thought to be an escapement level that could ensure continuing population levels sufficient to accomplish future escapement objectives as well as provide an adequate surplus for harvest. Chinook salmon escapement objectives were not achieved at the weir from 1983 to 1987 (Figure 6). The chinook escapement objective was met in 1988, 1989, and 1990 although the species has been passively managed due to the abundance of chum salmon.

The improvement in chinook escapement levels in 1988, 1989, and 1990 (Figure 6) may be attributable to a significant decrease in some mortality factor as indicated by the relatively high survival rate of the 1983 brood year cohort (Appendix A.1). The 1985 cohort also seems to be showing early signs of relatively low mortality as indicated by strong returns of ages 1.2 in 1989 and 1.3 in 1990. It appears from those indicators that Kogrukluk River returns in 1991 should be at least as strong as in 1990. Any major difference in the 1991 escapement level will be expected to be the result of differences in the prosecution of the commercial fishery.

Sockeye

Sockeye salmon have historically not been important in the Kuskokwim River subsistence or commercial economies. Much larger returns in 1986 and 1987, as evidenced in the commercial catch, are thought to be a temporary anomaly. Much lower commercial harvests in 1988 and 1989 seem to support this idea.

Sockeye escapement estimates for the Kogrukluk River have exceeded the escapement objective more often and by a larger magnitude than they have fallen short (Figure 6). However, in light of the low emphasis on the species and its fluctuating status, the objective seems reasonable at this time.

Coho

Coho salmon are an economically important species in the Kuskokwim area for which there is little capability to monitor escapements at this time. If the stock were to decline, the Department would have very little ability to take corrective action without resorting to an overly conservative management regime, an option which does not optimize allocation of the resource between users and escapements.

The return of coho to the weir in 1990 appears to be weak, even when late migration timing is assumed. The low water levels at the weir up until early September may be a mitigating factor, causing the coho to hold in the Holitna River until high waters made travel upstream easier. Although the weir was operated during the historical coho peak migration period (August 27 - September 8), large numbers of coho could have passed the weir site after high water made operation impossible.

Chum

The chum salmon escapement objective (30,000) seems reasonable. The symmetry displayed in Figure 6 demonstrates that the escapement objective is exceeded as often and by as much as it is fallen short of. The unexpectedly large chum returns in 1988 and 1989 as indicated by the large commercial harvests and good to excellent weir and Aniak River escapements (Schneiderhan 1988, 1989a) may be a sign that unknown factors are operating to create a lower prefishing mortality than anticipated. Improved weir returns per spawner for the 1983 and 1984 brood year cohorts (Appendix A.3) is also evidence of recent improved survival.

Gill Net Marked Salmon

The frequency of gill net marks on the various salmon species passed through the weir would appear to have potential to provide valuable information about changes in the effectiveness of the fishery when gear types or the timing or intensity of the fishery change. However, limited analyses of chinook data have been inconclusive.

TABLES

Table 1. Daily salmon counts by sex, Kogrukluk Weir, 1990.

	Chinook			Sockeye			Coho			Chum		
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
28-Jun	2	0	2	0	0	0	0	0	0	16	2	18
29-Jun	22	1	23	0	0	0	0	0	0	53	16	69
30-Jun	110	9	119	4	1	5	0	0	0	110	21	131
01-Jul	40	9	49	2	4	6	0	0	0	156	23	179
02-Jul	411	52	463	39	38	77	0	0	0	609	137	746
03-Jul	325	36	361	94	61	155	0	0	0	780	257	1037
04-Jul	162	17	179	67	40	107	0	0	0	1131	308	1439
05-Jul	369	58	427	168	103	271	0	0	0	1476	307	1783
06-Jul	389	64	453	289	171	460	0	0	0	1282	310	1592
07-Jul	227	28	255	174	127	301	0	0	0	652	149	801
08-Jul	694	148	842	379	255	634	0	0	0	1332	409	1741
09-Jul	131	20	151	104	100	204	0	0	0	845	244	1089
10-Jul	1011	217	1228	485	342	827	0	0	0	1469	518	1987
11-Jul	440	88	528	260	177	437	0	0	0	1013	401	1414
12-Jul	812	189	1001	376	241	617	0	0	0	744	249	993
13-Jul	94	17	111	65	51	116	0	0	0	551	177	728
14-Jul	320	67	387	355	167	522	0	0	0	693	179	872
15-Jul	694	361	1055	457	280	737	0	0	0	1173	380	1553
16-Jul	448	199	647	292	171	463	0	0	0	913	310	1223
17-Jul	141	77	218	249	160	409	0	0	0	477	187	664
18-Jul	276	132	408	283	146	429	0	0	0	830	287	1117
19-Jul	39	21	60	47	43	90	0	0	0	119	84	203
20-Jul	59	38	97	119	38	157	0	0	0	331	72	403
21-Jul	126	71	197	116	67	183	0	0	0	472	135	607
22-Jul	74	27	101	155	38	193	0	0	0	342	99	441
23-Jul	68	60	128	96	41	137	0	0	0	245	71	316
24-Jul	36	21	57	49	24	73	0	0	0	47	29	76
25-Jul	22	15	37	38	19	57	0	0	0	64	35	99
26-Jul	36	19	55	0	83	83	0	0	0	0	95	95
27-Jul	21	14	35	17	4	21	0	0	0	40	55	95
28-Jul	29	15	44	61	12	73	0	0	0	77	85	162
29-Jul	31	39	70	90	27	117	0	0	0	237	125	362
30-Jul	21	26	47	58	23	81	0	0	0	206	118	324
31-Jul	23	33	56	51	9	60	0	0	0	213	68	281
01-Aug	23	22	45	45	14	59	0	0	0	249	99	348
02-Aug	18	24	42	43	21	64	1	0	1	296	127	423
03-Aug	21	8	29	34	11	45	1	1	2	208	90	298
04-Aug	6	5	11	9	8	17	0	1	1	153	82	235
05-Aug	7	7	14	17	11	28	2	5	7	106	51	157
06-Aug	7	4	11	11	1	12	5	3	8	50	28	78
07-Aug	6	0	6	13	1	14	6	1	7	43	32	75
08-Aug	5	4	9	9	4	13	5	4	9	29	12	41
09-Aug	5	2	7	4	1	5	6	3	9	38	11	49
10-Aug	2	0	2	1	0	1	10	2	12	36	10	46
11-Aug	8	2	10	3	1	4	31	11	42	33	9	42
12-Aug	2	2	4	2	4	6	66	21	87	29	10	39
13-Aug	2	0	2	3	1	4	20	6	26	11	7	18
14-Aug	1	0	1	0	3	3	38	21	59	12	11	23
15-Aug	3	0	3	2	0	2	21	9	30	8	4	12
16-Aug	2	0	2	0	0	0	13	3	16	4	2	6
17-Aug	0	0	0	3	0	3	193	39	232	8	3	11
18-Aug	0	1	1	0	0	0	53	19	72	0	1	1
19-Aug	0	1	1	0	0	0	10	3	13	3	1	4
20-Aug	0	0	0	0	0	0	6	7	13	2	1	3
21-Aug	1	0	1	0	0	0	29	14	43	1	1	2
22-Aug	0	0	0	0	0	0	44	13	57	0	0	0
23-Aug	0	1	1	0	0	0	107	34	141	0	0	0
24-Aug	0	0	0	0	0	0	109	46	155	1	0	1
25-Aug	0	0	0	0	0	0	70	27	97	1	0	1
26-Aug	0	0	0	0	0	0	280	128	408	0	0	0
27-Aug	0	0	0	0	0	0	52	10	62	1	0	1
28-Aug	0	0	0	0	0	0	7	3	10	0	0	0

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Table 1. (continued) page 2 of 2.

Date	Chinook Male	Chinook Female	Chinook Total	Sockeye Male	Sockeye Female	Sockeye Total	Coho Male	Coho Female	Coho Total	Chum Male	Chum Female	Chum Total
29-Aug	0	0	0	0	0	0	17	2	19	1	0	1
30-Aug	0	0	0	0	0	0	10	1	11	0	0	0
31-Aug	0	0	0	0	0	0	18	3	21	0	0	0
01-Sep	0	0	0	1	0	1	16	7	23	0	0	0
02-Sep	0	0	0	0	0	0	63	6	69	0	0	0
03-Sep	0	0	0	0	0	0	44	3	47	0	0	0
04-Sep	0	0	0	0	0	0	98	30	128	0	0	0
05-Sep	0	0	0	0	0	0	330	60	390	0	0	0
06-Sep	0	0	0	0	0	0	143	38	181	0	0	0
07-Sep	0	0	0	0	0	0	4	1	5	0	0	0
08-Sep	0	0	0	0	0	0	18	0	18	0	0	0
09-Sep	0	0	0	0	0	0	163	42	205	0	0	0
Total	7822	2271	10093	5239	3144	8383	2109	627	2736	20021	6534	26555

Table 2. **Factor table for historical escapement estimates, Kogrukluk River, 1976-90.**

	Chinook				Sockeye				Coho[a]				Chum			
Year	T[b]	Count	Prop. Missed	Est. Total	T[b]	Count	Prop. Missed	Est. Total	T[b]	Count	Prop. Missed	Est. Total	T[b]	Count	Prop. Missed	Est. Total
1976	L	5,507	0.0534	5,818	N	2,302	0.0271	2,366					N	8,046	0.0441	8,417
1977	(N)	763	0.6078	1,945	(N)	732	0.5527	1,637					(N)	7,404	0.6192	19,444
1978	N	13,132	0.0345	13,601	N	1,656	0.0255	1,699					N	47,099	0.0390	49,010
1979	N	10,125	0.1134	11,420	N	425	0.1063	476					L	3,684	0.2383	4,836
1980		676	c	6,572		403	c	3,200						5,638	c	41,777
1981	E	16,075	0.0443	16,820	E	17,702	0.0208	18,077	N	11,532	0.0004	11,537	E	56,270	0.0192	57,373
1982	E	5,325	0.5630	12,185	E	11,729	0.4706	22,156	N	35,581	0.1192	40,395	E	41,208	0.4822	79,580
1983	(N)	1,032	0.6551	2,992	(N)	375	0.6812	1,176	L	8,327	0.0218	8,513	(N)	3,248	0.6547	9,407
1984	N	4,928	0.0000	4,928	N	4,130	0.0000	4,130	E	25,304	0.0465	26,538	N	41,484	0.0000	41,484
1985	L	4,306	0.0297	4,438	L	4,344	0.0050	4,366	E	14,064	0.2406	18,520	L	15,834	0.0784	17,181
1986	L	2,968	0.3092	4,296	N	3,308	0.2084	4,179	E	14,717	0.3133	21,431	N	12,072	0.2217	15,511
1987		d		4,063		d		973[e]	N	19,805	0.2344	25,870		d		17,422
1988	E	7,665	0.3153	11,194	E	4,220	0.3147	6,158	N	11,722	0.0841	12,799	E	28,294	0.3244	41,881
1989	N	4,908	0.5889	11,940	N	2,597	0.5530	5,810				f	N	15,541	0.6070	39,548
1990	N	10,093	0.0130	10,218	N	8,383	0.0030	8,406	L	2,736	0.5538	6,132	L	26,555	0.0073	26,750

a Coho migrations were not monitored prior to 1981.

b The timing model used for estimating missed counts depends on the distribution of mean date of migration from appendices C - F (E=early, N=normal, L=late). The use of parentheses () indicates assumed timing.

c From Baxter (1980); insufficient data to estimate escapements using time series techniques.

d Except for coho, escapements were estimated from a ratio of unknown 1987 escapement and known 1987 aerial assessment to known 1988 escapement and known 1988 aerial assessment. Coho escapements estimated using time series techniques.

e Aerial sockeye counts in riverine spawning habitat are subject to a wide range of error when surveys are not targeting the species.

f He[illegible]in and high river levels allowed only two days of counts during the coho migration.

Table 3. Historical escapement estimates and percent of objectives achieved, Kogrukluk River, 1976-90.

Escapement Objectives			
Chinook	Sockeye	Coho	Chum
10,000	2,000	25,000	30,000

	Escapement Estimates				Percent of Objective			
Year	Chinook	Sockeye	Coho	Chum	Chinook	Sockeye	Coho	Chum
1976	5,818	2,366		8,417	58	118	a	28
1977	1,945	1,637		19,444	19	82	a	65
1978	13,601	1,699		49,010	136	85	a	163
1979	11,420	476		4,836	114	24	a	16
1980	6,572	3,200		41,777	66	160	a	139
1981	16,820	18,077	11,537	57,373	168	904	46	191
1982	12,185	22,156	40,395	79,580	122	1108	162	265
1983	2,992	1,176	8,513	9,407	30	59	34	31
1984	4,928	4,130	26,538	41,484	49	207	106	138
1985	4,438	4,366	18,520	17,181	44	218	74	57
1986	4,296	4,179	21,431	15,511	43	209	86	52
1987[b]	4,063	973	25,870	17,422	41	49	103	58
1988	11,194	6,158	12,799	41,881	112	308	51	140
1989	11,940	5,810	c	39,548	119	291	c	132
1990	10,218	8,406	6,132	26,750	102	420	25	89
Average					81.6	282.7	45.8	104.4

a Coho were not counted prior to 1981.

b Chinook, sockeye and chum were estimated using 1987 aerial and 1988 aerial and weir data. This should be revised as more same-year aerial and weir data becomes available.

c Heavy rain and high river levels allowed only two days of counts during the coho migration.

Table 4. Daily salmon carcass counts, Kogrukluk Weir, 1990.

	Chinook	Sockeye	Pink	Chum
28-Jun	0	0	0	0
29-Jun	0	0	0	0
30-Jun	0	0	0	0
01-Jul	0	0	0	1
02-Jul	0	0	0	0
03-Jul	0	1	0	8
04-Jul	0	0	0	6
05-Jul	0	0	0	3
06-Jul	0	0	0	0
07-Jul	0	0	0	10
08-Jul	0	1	0	13
09-Jul	0	0	0	32
10-Jul	0	0	0	30
11-Jul	0	1	0	34
12-Jul	0	0	0	31
13-Jul	0	1	0	61
14-Jul	0	0	0	107
15-Jul	0	0	0	101
16-Jul	0	0	0	235
17-Jul	1	0	0	176
18-Jul	0	0	0	234
19-Jul	0	3	0	383
20-Jul	0	1	0	316
21-Jul	0	0	0	275
22-Jul	0	2	0	243
23-Jul	2	1	0	333
24-Jul	2	0	0	313
25-Jul	1	1	0	291
26-Jul	2	1	0	303
27-Jul	6	2	0	389
28-Jul	13	1	0	231
29-	19	2	1	241
3[illegible]	7	0	0	86
31	30	0	0	197
01-Aug	40	2	1	147
02-Aug	45	2	0	151
03-Aug	51	4	0	107
04-Aug	51	3	0	83
05-Aug	59	6	0	103
06-Aug	56	6	0	52
07-Aug	65	2	0	48
08-Aug	23	8	0	42
09-Aug	52	20	0	56
10-Aug	37	27	0	46
11-Aug	31	36	0	86
12-Aug	26	33	0	55
13-Aug	22	40	0	59
14-Aug	4	27	0	57
15-Aug	5	40	0	42
16-Aug	10	32	1	32
17-Aug	4	53	0	21
18-Aug	8	22	0	24
19-Aug	2	37	0	17
20-Aug	2	12	0	16
21-Aug	0	17	0	23
22-Aug	0	8	0	9
23-Aug	1	13	0	12
24-Aug	0	14	0	7
25-Aug	2	10	0	6
26-Aug	0	6	0	8
27-Aug	0	17	0	6
28-Aug	0	7	0	6
29-Aug	0	9	0	0

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Table 4. (page 2 of 2)

Date	Chinook	Sockeye	Pink	Chum
30-Aug	0	6	0	0
31-Aug	1	3	0	0
01-Sep	0	6	0	0
02-Sep	3	0	0	0
03-Sep	1	5	0	0
04-Sep	0	1	0	0
05-Sep	0	2	0	0
06-Sep	0	1	0	0
07-Sep	0	0	0	0
08-Sep	0	1	0	0
09-Sep	0	0	0	0
Total	684	556	3	6004

Table 5. Length at age summary for Kogrukluk weir chinook salmon escapement sample, 1990.

	Age Class				
	1.1	1.2	1.3	1.4	1.5
Females					
Mean Length	.0	.0	831.9	865.3	852.0
Std. Error	.00	.00	7.14	9.02	.00
Range	0-0	0-0	740-963	760-975	852-852
Sample Size	0	0	41	28	1
Males					
Mean Length	572.4	583.0	726.2	850.6	.0
Std. Error	12.17	4.25	4.56	15.42	.00
Range	519-639	500-685	540-873	775-930	0-0
Sample Size	9	99	178	11	0
All Fish					
Mean Length	572.4	583.0	746.0	861.1	852.0
Std. Error	12.17	4.25	4.82	7.76	.00
Range	519-639	500-685	540-963	760-975	852-852
Sample Size	9	99	219	39	1

Table 6. Length at age summary for Kogrukluk weir sockeye salmon escapement sample, 1990.

	Age Class			
	0.3	0.4	1.3	1.4
Females				
Mean Length	544.0	.0	542.0	577.0
Std. Error	.00	.00	2.41	13.49
Range	544-544	0-0	500-572	533-613
Sample Size	1	0	40	5
Males				
Mean Length	508.0	608.0	577.7	587.3
Std. Error	.00	.00	1.99	8.07
Range	508-508	608-608	514-630	570-609
Sample Size	1	1	102	4
All Fish				
Mean Length	526.0	608.0	567.7	581.6
Std. Error	18.00	.00	2.08	8.04
Range	508-544	608-608	500-630	533-613
Sample Size	2	1	142	9

Table 7. Length at age summary for Kogrukluk weir coho salmon escapement sample, 1990.

	Age Class		
	1.1	2.1	3.1
Females			
Mean Length	574.0	558.7	580.8
Std. Error	.00	5.59	7.83
Range	574-574	513-600	562-598
Sample Size	1	18	4
Males			
Mean Length	561.9	569.6	558.8
Std. Error	7.53	2.37	6.72
Range	523-598	491-620	517-588
Sample Size	10	128	12
All Fish			
Mean Length	563.0	559.5	564.3
Std. Error	6.89	2.17	5.79
Range	523-598	491-620	517-598
Sample Size	11	146	16

Table 8. Length at age summary for Kogrukluk weir chum salmon escapement sample, 1990.

	Age Class		
	0.3	0.4	0.5
Females			
Mean Length	569.8	581.7	.0
Std. Error	3.49	4.59	.00
Range	522-645	550-630	0-0
Sample Size	64	20	0
Males			
Mean Length	580.5	611.1	624.0
Std. Error	2.03	3.97	8.92
Range	512-698	500-710	605-648
Sample Size	215	79	4
All Fish			
Mean Length	578.1	605.1	624.0
Std. Error	1.78	3.50	8.92
Range	512-698	500-710	605-648
Sample Size	279	99	4

Table 9. Chinook salmon spawner escapements apportioned by age class and sex, Kogrukluk River, 1976-1990.

Year		Age Class 1.1	1.2	1.3	1.4	1.5	Total	Female
1976	Percent	0.3	7.2	39.5	52.7	0.3	100.0	45.1
	Number	17	419	2298	3066	17	5818	2624
1977	Percent	0.0	3.6	21.8	72.9	1.7	100.0	60.2
	Number	0	70	424	1418	33	1945	1171
1978	Percent	0.0	16.9	10.2	72.9	0.0	100.0	47.7
	Number	0	2299	1387	9915	0	13601	6488
1979	Percent	0.0	63.1	15.5	21.4	0.0	100.0	17.8
	Number	0	7206	1770	2444	0	11420	2033
1980	Percent	0.0	30.2	47.6	14.3	7.9	100.0	15.9
	Number	0	1985	3128	940	519	6572	1045
1981	Percent	0.0	6.5	33.6	58.7	1.2	100.0	47.0
	Number	0	1093	5652	9873	202	16820	7905
1982	Percent	0.3	15.1	21.2	57.8	5.6	100.0	49.2
	Number	37	1840	2583	7043	682	12185	5995
1983	Percent	0.2	20.3	23.9	51.2	4.4	100.0	28.9
	Number	6	607	715	1532	132	2992	865
19.	.ercent	0.3	21.1	46.9	27.8	3.9	100.0	22.7
	Number	15	1040	2311	1370	192	4928	1119
1985	Percent	0.0	17.1	34.7	45.2	3.0	100.0	32.2
	Number	0	759	1540	2006	133	4438	1429
1986	Percent	0.1	8.7	58.3	27.1	5.7	100.0	23.0
	Number	6	373	2505	1164	247	4296	987
1987	Percent	0.0	25.6	24.8	48.7	0.9	100.0	3.4
	Number	0	1040	1008	1979	37	4063	a
1988	Percent	0.0	9.0	51.3	31.1	8.6	100.0	34.4
	Number	0	1006	5739	3482	967	11194	3848
1989	Percent	0.0	14.7	25.3	58.1	1.8	100.0	34.6
	Number	0	1761	3026	6933	220	11940	4127
1990	Percent	2.5	27.0	59.6	10.6	0.3	100.0	22.5
	Number	255	2759	6090	1083	31	10218	2299

a Sex composition data was unacceptable.

Table 10. Sockeye salmon spawner escapements apportioned by age class and sex, Kogrukluk River, 1976-1990.

		Age Class								
Year		0.3	1.2	0.4	1.3	0.5	1.4	Other	Total	Female
1976	Percent	0.0	0.0	0.0	99.4	0.0	0.6	0.0	100.0	14.0
	Number	0	0	0	2352	0	14	0	2366	331
1977	Percent	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	19
	Number	0	0	0	1637	0	0	0	1637	311
1978	Percent	0.0	2.4	0.0	90.8	0.0	6.8	0.0	100.0	57
	Number	0	41	0	1543	0	116	0	1699	968
1979	Percent	0.0	0.0	0.0	98.8	0.0	1.2	0.0	100.0	50
	Number	0	0	0	470	0	6	0	476	238
1980	Percent	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	44.8
	Number	0	0	0	3200	0	0	0	3200	1434
1981	Percent	0.0	22.9	0.0	77.1	0.0	0.0	0.0	100.0	50.7
	Number	0	4140	0	13937	0	0	0	18077	9165
1982	Percent	0.0	0.5	0.0	87.4	0.0	11.7	0.5	100.0	37.4
	Number	0	100	0	19362	0	2594	100	22156	8286
1983	Percent	0.0	23.6	0.0	71.9	0.0	4.5	0.0	100.0	60.7
	Number	0	278	0	846	0	53	0	1176	714
1984	Percent	0.0	1.2	0.0	94.0	0.1	2.4	2.3	100.0	41.9
	Number	0	50	0	3882	4	99	95	4130	1730
1985	Percent	5.9	1.7	0.2	88.8	2.9	0.5	0.0	100.0	49.2
	Number	258	74	9	3877	127	22	0	4366	2148
1986	Percent	1.6	0.3	0.0	95.6	0.0	2.5	0.0	100.0	51.3
	Number	67	13	0	3995	0	104	0	4179	2144
1987	Percent	2.3	0	0	97.7	0.0	0.0	0.0	100.0	60.5
	Number	22	0	0	951	0	0	0	973	589
1988	Percent	0.0	1.8	0.0	94.8	0.0	2.1	1.2	100.0	52.7
	Number	0	113	0	5839	0	131	75	6158	3245
1989	Percent	0.0	0.0	0.0	95.6	0.0	1.5	2.9	100.0	60.3
	Number	0	0	0	5554	0	85	171	5810	3503
1990	Percent	1.4	0.0	0.6	92.2	0.0	5.8	0.0	100.0	37.5
	Number	118	0	50	7750	0	488	0	8406	3152

Table 11. Chum salmon spawner escapements apportioned by age class and sex, Kogrukluk River, 1976-1990.

Year		Age Class 0.2	0.3	0.4	0.5	Total	Female
1976	Percent	0.5	37.0	62.5	0.0	100.0	18.5
	Number	42	3114	5261	0	8417	1557
1977	Percent	0.0	62.8	29.9	7.3	100.0	26.3
	Number	0	12211	5814	1419	19444	5114
1978	Percent	1.6	45.4	53.0	0.0	100.0	44.5
	Number	784	22251	25975	0	49010	21809
1979	Percent	5.7	82.5	11.8	0.0	100.0	32.0
	Number	276	3990	571	0	4836	1548
1980	Percent	0.0	89.2	10.8	0.0	100.0	9.6
	Number	0	37265	4512	0	41777	4011
1981	Percent	0.0	13.6	86.4	0.0	100.0	36.9
	Number	0	7803	49570	0	57373	21171
1982	Percent	0.0	70.9	28.7	0.4	100.0	43.0
	Number	0	56422	22839	318	79580	34219
83	Percent	0.4	22.1	75.8	1.7	100.0	41.3
	Number	38	2079	7131	160	9407	3885
1984	Percent	0.0	77.7	19.5	2.8	100.0	32.6
	Number	0	32233	8089	1162	41484	13524
1985	Percent	0.2	30.3	69.0	0.5	100.0	45.3
	Number	34	5206	11855	86	17181	7783
1986	Percent	0.4	69.6	27.5	2.5	100.0	36.8
	Number	62	10796	4266	388	15511	5708
1987	Percent	0.0	22.5	69.4	8.1	100.0	45.0
	Number	0	3920	12091	1411	17422	7840
1988	Percent	0.0	69.2	28.8	1.9	100.0	35.6
	Number	0	29000	12072	809	41881	14905
1989	Percent	0.0	19.7	76.9	3.4	100.0	29.9
	Number	0	7802	30401	1345	39548	11837
1990	Percent	0.0	73.1	25.9	1.0	100.0	24.6
	Number	0	19565	6932	268	26750	6584

Table 12. Daily counts of gill net marked salmon by sex, Kogrukluk Weir, 1990.

	Chinook		Sockeye		Coho		Chum	
Date	Male	Female	Male	Female	Male	Female	Male	Female
28-Jun	0	0	0	0	0	0	0	0
29-Jun	2	0	0	0	0	0	9	1
30-Jun	9	1	0	0	0	0	13	3
01-Jul	2	0	0	0	0	0	8	4
02-Jul	51	4	1	0	0	0	34	7
03-Jul	26	3	1	0	0	0	33	13
04-Jul	9	1	0	0	0	0	43	11
05-Jul	34	9	8	2	0	0	66	14
06-Jul	23	3	11	8	0	0	48	15
07-Jul	13	1	1	1	0	0	22	4
08-Jul	56	12	9	2	0	0	50	13
09-Jul	5	0	1	0	0	0	23	5
10-Jul	82	21	6	12	0	0	47	15
11-Jul	40	7	12	11	0	0	34	9
12-Jul	91	32	10	4	0	0	28	5
13-Jul	14	1	0	2	0	0	29	12
14-Jul	62	16	26	11	0	0	25	12
15-Jul	99	49	19	8	0	0	27	12
16-Jul	73	47	6	6	0	0	23	7
17-Jul	20	9	14	3	0	0	14	3
18-Jul	55	27	16	2	0	0	18	5
19-Jul	9	5	2	1	0	0	6	2
20-Jul	13	2	4	0	0	0	5	2
21-Jul	25	15	5	0	0	0	13	5
22-Jul	12	6	7	0	0	0	10	6
23-Jul	16	14	1	1	0	0	13	5
24-Jul	9	5	4	0	0	0	6	0
25-Jul	4	10	0	2	0	0	4	1
26-Jul	5	3	1	1	0	0	0	1
27-Jul	5	5	0	1	0	0	7	0
28-Jul	4	5	2	0	0	0	2	2
29-Jul	1	3	1	0	0	0	6	2
30-Jul	4	3	0	0	0	0	3	2
31-Jul	9	8	0	0	0	0	5	0
01-Aug	3	7	2	0	0	0	6	3
02-Aug	4	7	0	0	0	0	12	4
03-Aug	4	1	2	1	0	0	11	10
04-Aug	0	0	0	0	0	0	3	4
05-Aug	0	1	0	0	0	0	8	7
06-Aug	2	2	4	0	0	0	2	2
07-Aug	1	0	1	0	0	0	1	2
08-Aug	2	1	1	0	1	0	5	1
09-Aug	1	0	1	0	0	0	6	1
10-Aug	0	0	0	0	1	0	2	1

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Table 12. (continued) page 2 of 2.

Date	Chinook Male	Chinook Female	Sockeye Male	Sockeye Female	Coho Male	Coho Female	Chum Male	Chum Female
11-Aug	0	1	0	0	0	0	3	0
12-Aug	0	0	0	0	2	0	1	3
13-Aug	0	0	0	0	1	0	2	0
14-Aug	0	0	0	0	2	0	0	1
15-Aug	0	0	0	0	0	0	1	0
16-Aug	0	0	0	0	0	0	2	0
17-Aug	0	0	1	0	2	0	4	0
18-Aug	0	1	0	0	0	1	0	0
19-Aug	0	1	0	0	0	0	2	0
20-Aug	0	0	0	0	0	0	0	0
21-Aug	0	0	0	0	0	1	0	0
22-Aug	0	0	0	0	0	0	0	0
23-Aug	0	1	0	0	5	0	0	0
24-Aug	0	0	0	0	0	0	0	0
25-Aug	0	0	0	0	2	0	0	0
26-Aug	0	0	0	0	11	3	0	0
27-Aug	0	0	0	0	0	0	1	0
28-Aug	0	0	0	0	0	0	0	0
29-Aug	0	0	0	0	1	0	0	0
30-Aug	0	0	0	0	0	0	0	0
31-Aug	0	0	0	0	0	0	0	0
01-Sep	0	0	0	0	0	0	0	0
02-Sep	0	0	0	0	0	0	0	0
03-Sep	0	0	0	0	0	0	0	0
04-Sep	0	0	0	0	1	0	0	0
05-Sep	0	0	0	0	6	1	0	0
06-Sep	0	0	0	0	1	0	0	0
07-Sep	0	0	0	0	0	0	0	0
08-Sep	0	0	0	0	2	0	0	0
09-Sep	0	0	0	0	4	3	0	0
Total	899	350	180	79	42	9	746	237

Table 13. Kogrukluk weir meteorological and hydrological observations, 1990.

Date	Time	Cloud Cover (%)	Percip. (mm)	Wind (mph)	Temp. (C) Air	Temp. (C) Water	Water level (mm)
6/26	1200	75	0.0	-	-	-	2680
6/27	1200	10	T	5	-	-	2670
6/28	1200	10	0.0	5	24	-	2650
6/29	1200	25	0.0	10	23	13	2620
6/30	1200	10	0.0	10	22	15	2590
7/01	1200	35	0.0	10	18	13	2560
7/02	1200	75	0.0	10	20	13	2530
7/03	1200	10	0.0	5	21	13	2510
7/04	1200	45	0.0	15	18	13	2490
7/05	1200	75	0.0	10	17	13	2480
7/06	1200	90	2.8	10	15	12	2460
7/07	1200	90	3.7	<5	15	11	2430
7/08	1200	80	T	10	15	12	2460
7/09	1200	40	T	15	12	12	2450
7/10	1200	100	0.0	10	17	12	2430
7/11	1200	60	T	10	15	12	2410
7/12	1200	60	0.0	15	14	11	2400
7/13	1200	100	0.0	25	13	10	2390
7/14	1200	90	T	10	15	10	2380
7/15	1200	10	0.0	5	17	11	2380
7/16	1200	25	0.0	10	20	11	2350
7/17	1200	10	0.0	10	23	12	2330
7/18	1200	10	0.0	5	18	12	2330
7/19	1200	10	0.0	15	20	12	2310
7/20	1200	10	0.0	10	22	12	2300
7/21	1200	100	T	20	19	13	2290
7/22	1200	100	0.0	5	20	12	2290
7/23	1200	100	0.4	10	16	12	2280
7/24	1200	100	4.2	10	14	12	2290
7/25	1200	90	0.8	10	14	11	2300
7/26	1200	90	T	<5	14	12	2296
7/27	1230	100	2.2	<5	15	11	2290
7/28	1230	75	9.8	10	15	11	2298
7/29	1200	75	2.2	10	13	11	2324
7/30	1200	100	5.8	10	11	11	2360
7/31	1200	100	3.0	5	11	10	2366
8/01	1200	100	2.6	<5	14	10	2390
8/02	1300	60	0.3	10	18	11	2430
8/03	1300	90	1.0	5	19	12	2396
8/04	1230	30	0.0	20	19	12	2370
8/05	1300	70	0.0	5	15	12	2338
8/06	1200	65	0.0	<5	12	11	2318
8/07	1300	75	0.0	15	15	11	2300
8/08	1300	70	0.0	10	15	11	2290
8/09	1200	90	0.0	10	15	11	2280

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Table 13. (continued) page 2 of 2

Date	Time	Cloud Cover (%)	Percip. (mm)	Wind (mph)	Temp. (C) Air	Water	Water level (mm)
8/10	1245	65	3.0	5	17	11	2278
8/11	1230	80	8.3	30	19	12	2286
8/12	1300	40	0.0	5	16	12	2330
8/13	1230	10	0.0	5	16	12	2314
8/14	1230	75	0.0	5	15	12	2284
8/15	1200	90	0.0	10	15	11	2270
8/16	1200	100	5.8	20	14	11	2266
8/17	1215	65	0.0	15	13	10	2358
8/18	1215	40	0.0	5	11	10	2416
8/19	1200	90	4.0	5	13	10	2356
8/20	1245	80	3.6	<5	13	10	2330
8/21	1230	90	0.0	10	12	10	2318
8/22	1200	50	2.0	10	13	10	2304
8/23	1145	90	0.0	10	13	10	2296
8/24	1200	100	2.2	5	13	10	2330
8/25	1200	100	4.3	15	13	10	2320
8/26	1200	75	0.6	5	16	11	2320
8/27	1200	60	T	5	13	12	2310
8/28	1200	75	2.3	10	10	10	2290
8/29	1215	75	0.0	5	14	10	2286
8/30	1200	90	4.0	5	10	10	2280
8/31	1200	65	0.0	5	11	9	2280
/01	1230	80	0.0	10	10	9	2276
9/02	1230	100	1.0	15	12	9	2266
9/03	1145	90	13.4	5	13	10	2270
9/04	1200	100	2.6	10	8	9	2336
9/05	1200	65	2.4	15	13	9	2350
9/06	1200	75	T	10	9	9	2330
9/07	1230	100	0.0	5	4	8	2306
9/08	1200	100	30.0	10	10	8	2316
9/09	1445	100	11.4	10	10	8	2590
9/10	1200	75	1.4	5	9	8	2840
9/11	1300	100	T	5	4	7	2740
9/12	1230	90	16.6	5	10	7	2730
9/13	1300	100	3.3	5	9	8	3060
9/14	1200	65	T	5	7	8	3010
9/15	1200	65	0.0	10	8	7	2920
9/16	1200	100	17.0	10	10	7	2840
9/17	1200	90	1.0	10	10	7	3020
9/18	1245	35	0.0	<5	6	6	4100

FIGURES

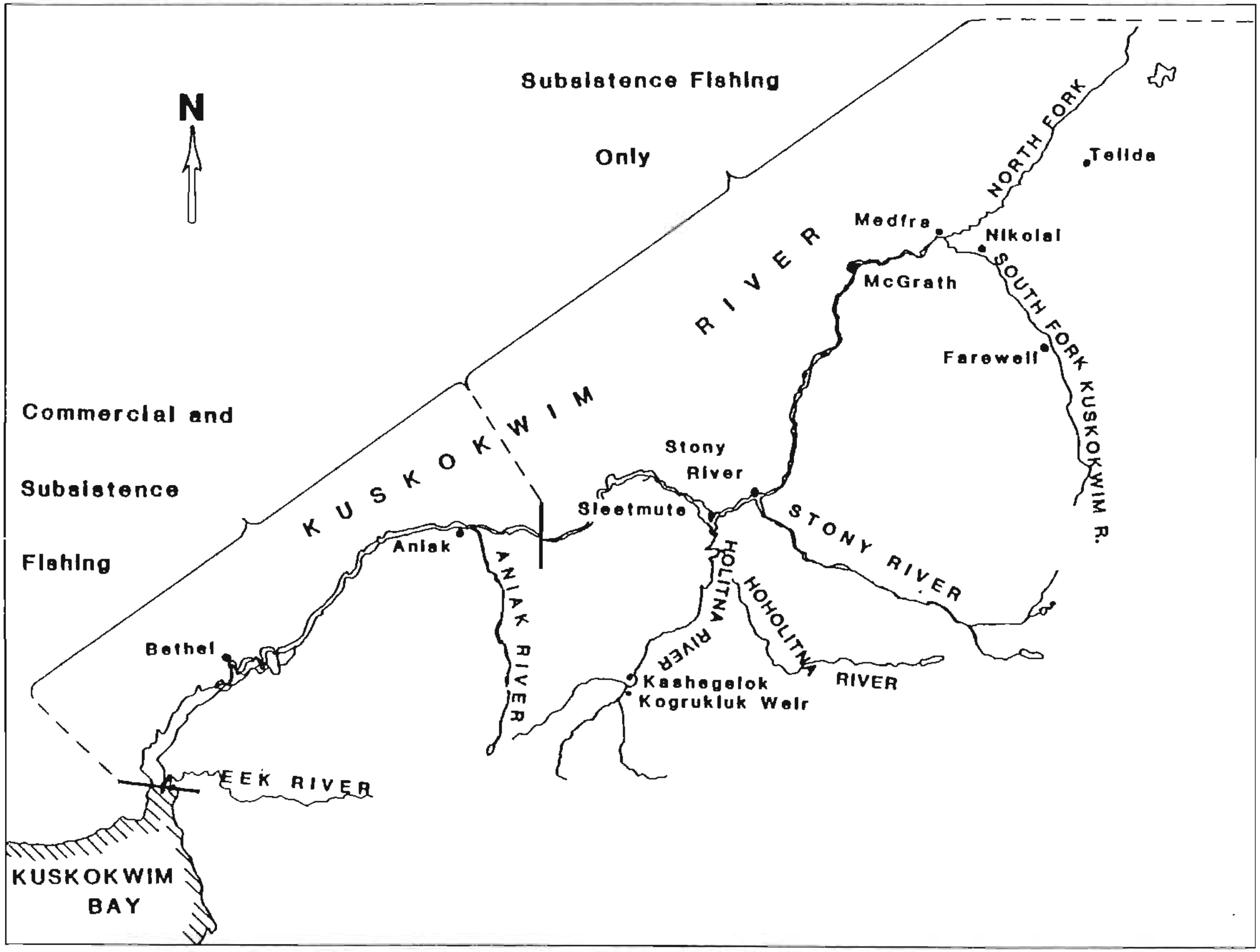

Figure 1. Kuskokwim River map.

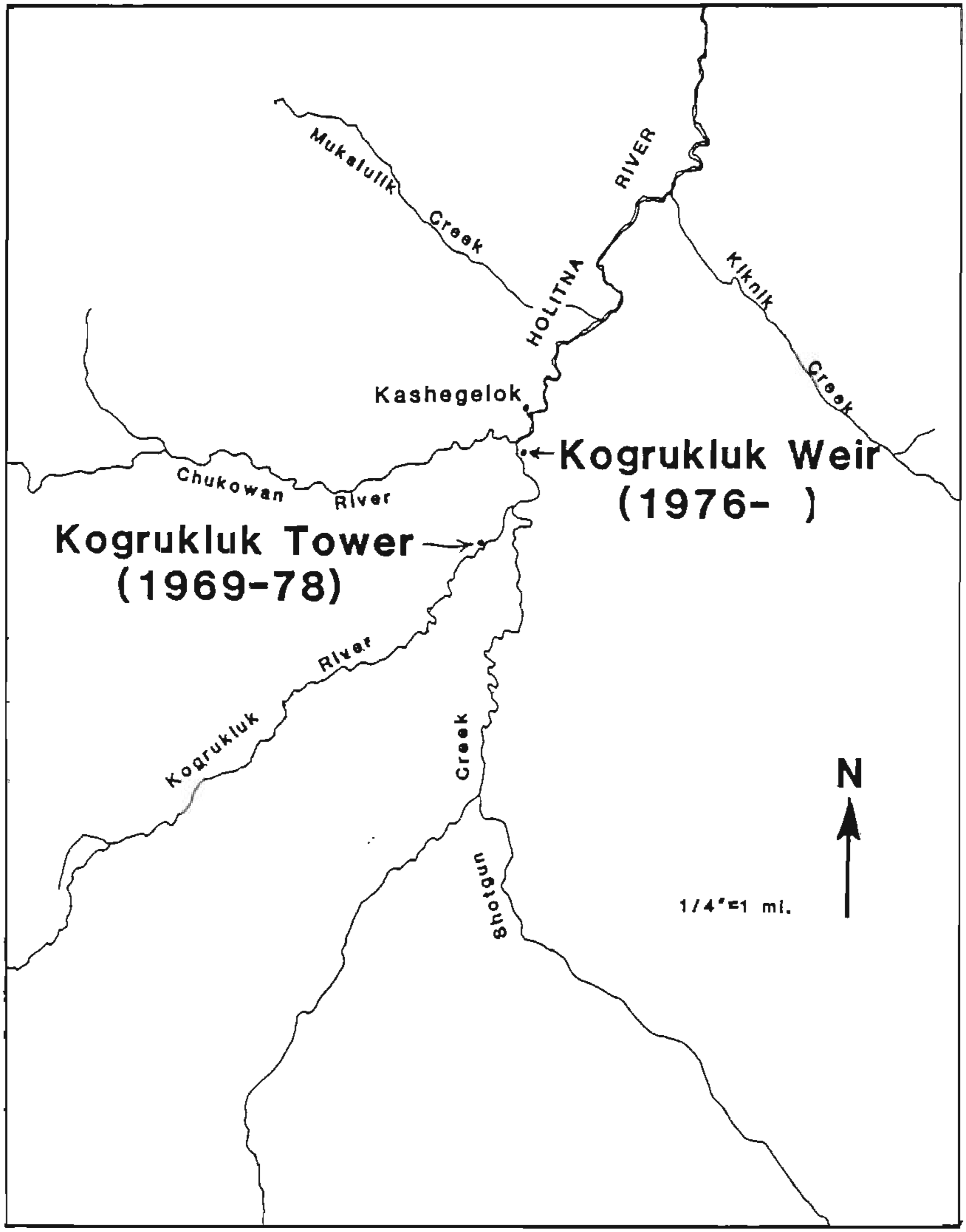

Figure 2. Upper Holitna River in the vicinity of the Kogrukluk Weir project.

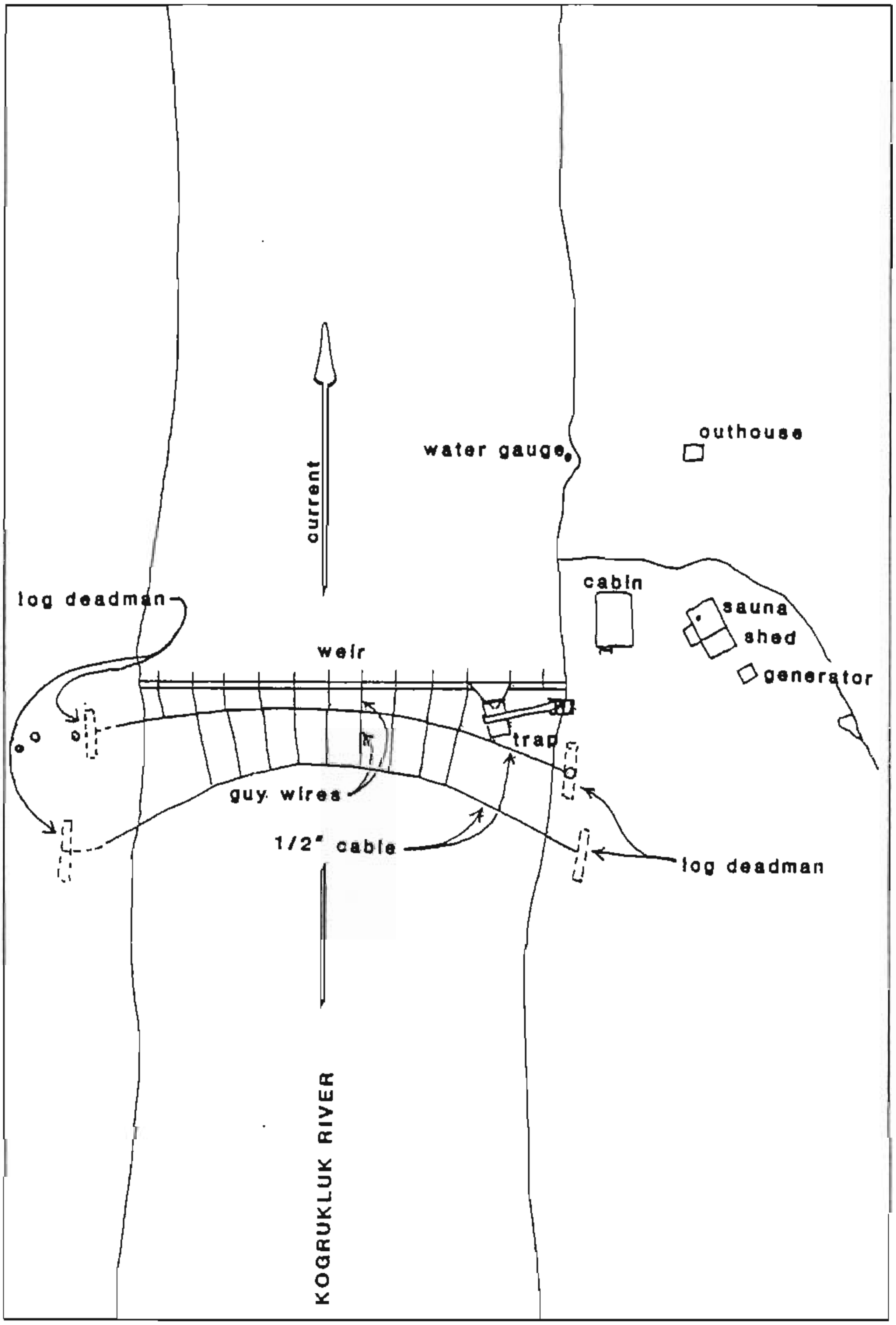

Figure 3. Kogrukluk Weir project.

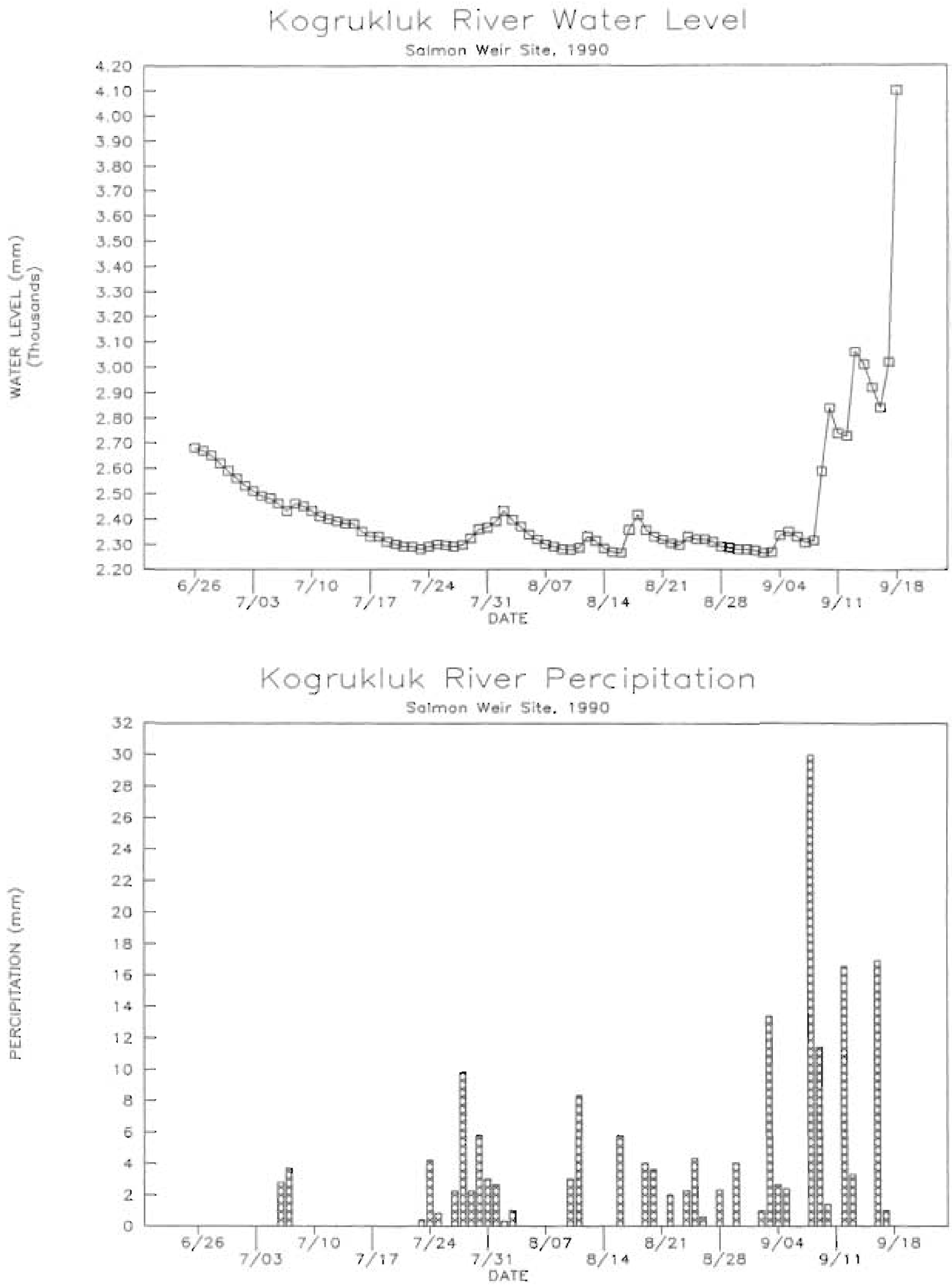

Figure 4. Relative water level and daily precipitation, Kogrukluk weir, 1990.

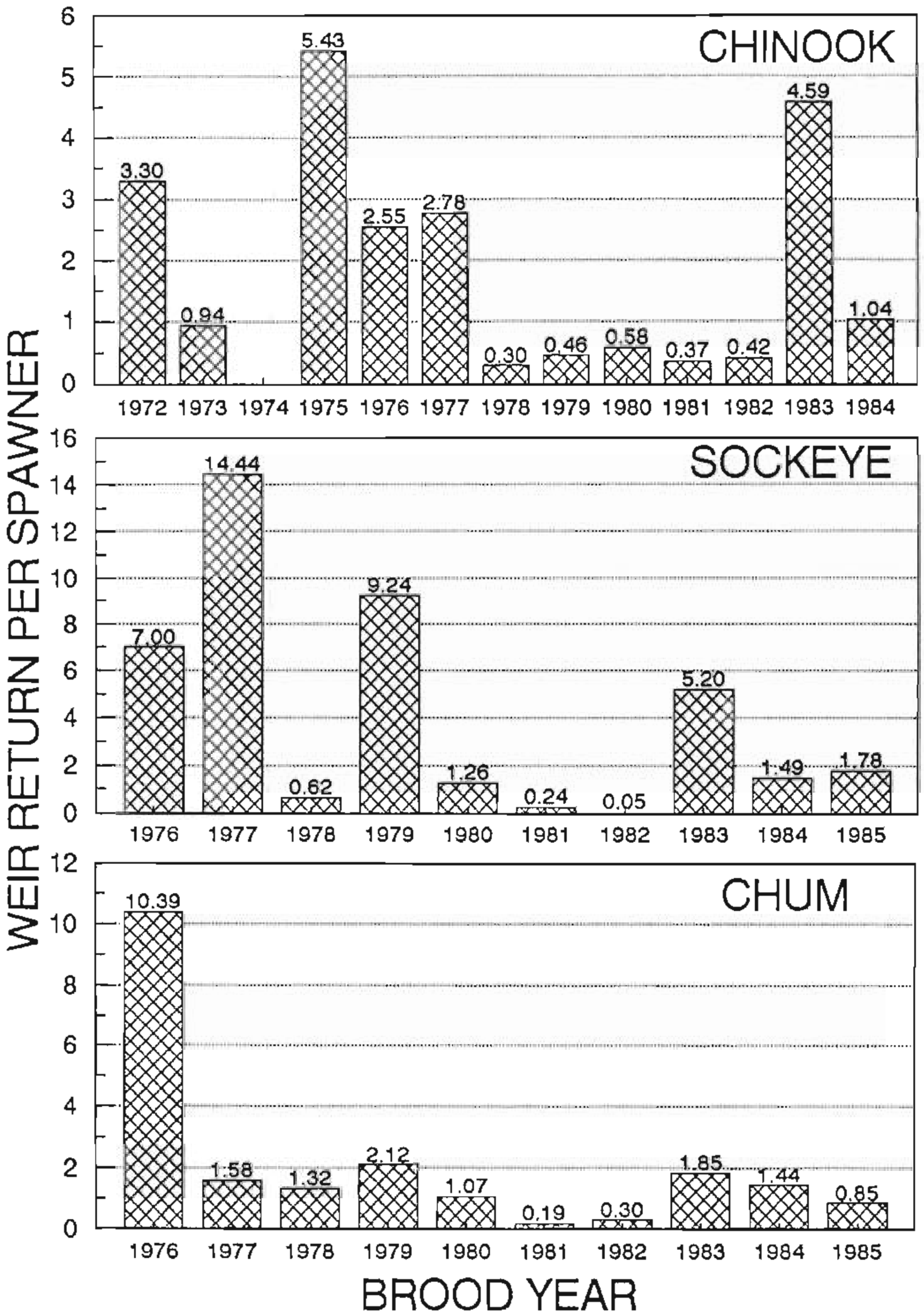

Figure 5. Estimated weir returns per spawner, Kogrukluk River, 1972-1986.

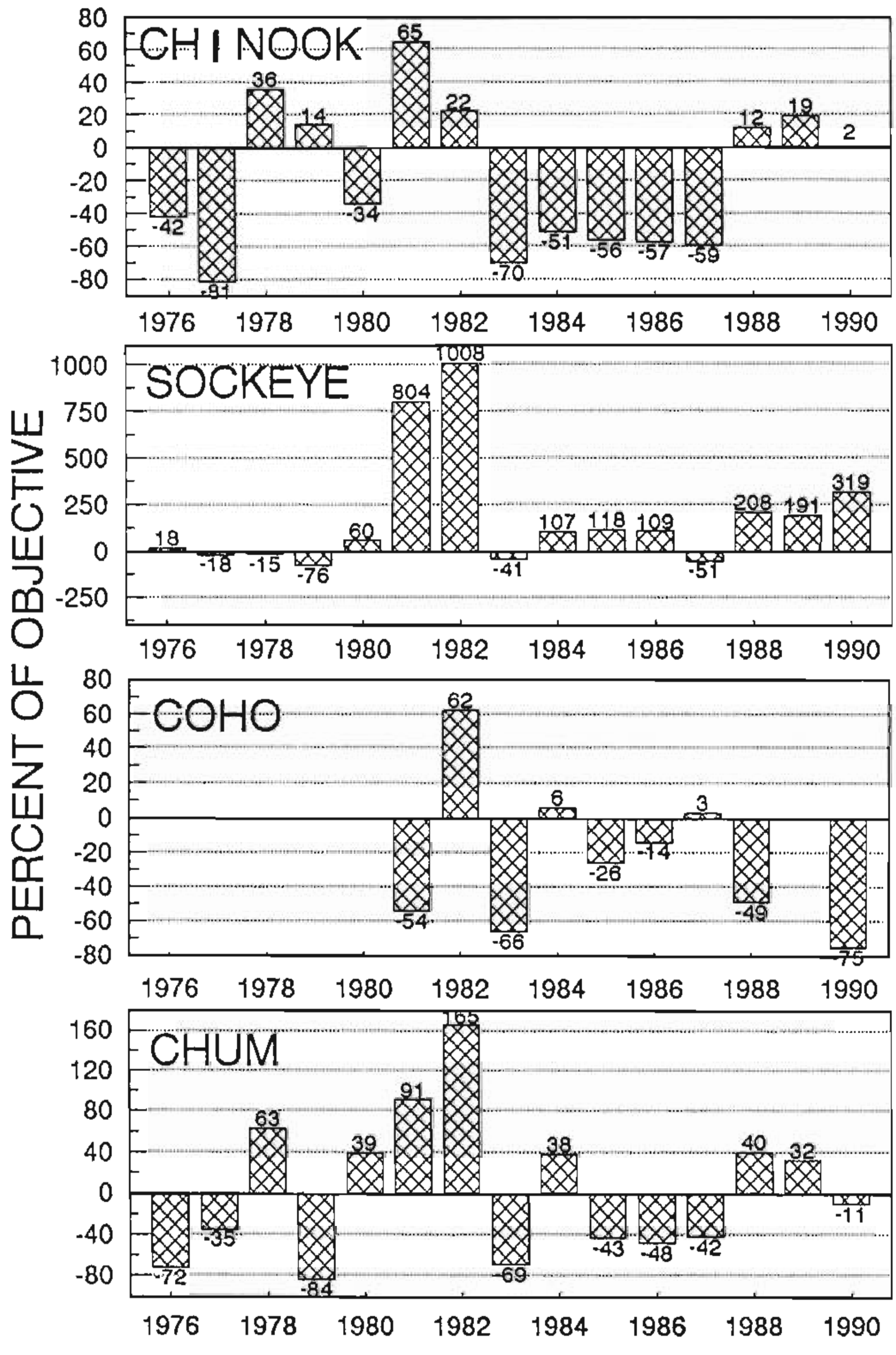

Figure 6. Percent deviation from weir escapement objectives, Kogrukluk River, 1976-1990.

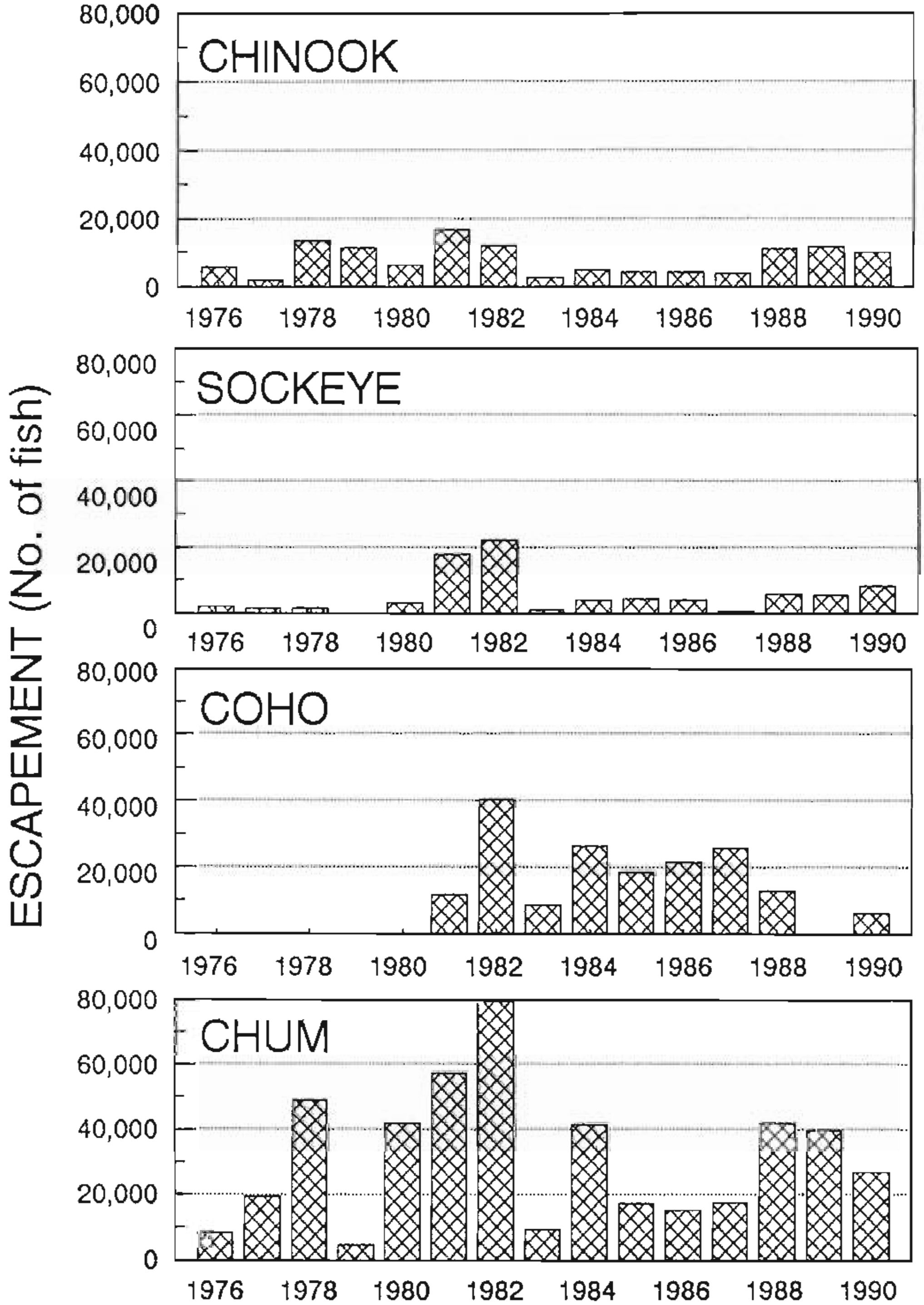

Figure 7. Estimated annual weir escapements, Kogrukluk River, 1976-1990.

APPENDICES

Appendix A.1. Chinook salmon brood year table, Kogrukluk River, 1969-1990.

Brood Year	Number of Spawners[a]	Age of Brood Year Cohort at Time of Return 1.1	1.2	1.3	1.4	1.5	Weir Return From Each Cohort[b]	Weir Return Per Spawner
1969	-	c	c	c	c	17	c	
1970	3912	c	c	c	3067	33	c	
1971	-	c	c	2298	1418	0	c	
1972	3258	c	419	424	9915	0	10758	3.30
1973	4734	17	70	1387	2444	519	4437	0.94
1974	-	0	2299	1770	940	202	5211	-
1975	3844	0	7206	3128	9874	682	20890	5.43
1976	5818	0	1985	5652	7043	132	14812	2.55
1977	1945	0	1092	2583	1532	192	5399	2.78
1978	13601	0	1840	715	1370	133	4058	0.30
1979	11420	37	607	2311	2006	247	5208	0.46
1980	6572	6	1040	1540	1164	37	3787	0.58
1981	16820	15	759	2506	1978	967	6225	0.37
1982	12185	0	373	1008	3482	220	5083	0.42
1983	2992	6	1040	5739	6933	30	13748	4.59
1984	4928	0	1006	3026	1069	-	5101	1.04
1985	4438	0	1761	6011	-	-	-	-
1986	4296	0	2723	-	-	-	-	-
1987[d]	4063	252	-	-	-	-	-	-
1988	11194	-	-	-	-	-	-	-
1989	11940	-	-	-	-	-	-	-
1990	10218	-	-	-	-	-	-	-

a Escapements prior to 1976 were estimated from tower counts. Comparability was obtained in 1977 when both tower and weir were operated successfully.
b Dominant age classes (1.2, 1.3, 1.4) are minimally used to estimate total weir return by cohort.
c Incomplete data on cohort returns.
d Weir counts in 1987 were insufficient to estimate escapements. However, 1977 aerial, 1988 aerial, and 1988 weir data was used to estimate the weir escapement.

Appendix A.2. Sockeye salmon brood year table, Kogrukluk River, 1969-1990.

Brood Year	Number of Spawners[a]	Age of Brood Year Cohort at Time of Return[b] 1.2	1.3	1.4	Weir Returns From Each Cohort[c]	Weir Return Per Spawner
1969	-	d	d	d	d	d
1970	-	d	d	14	d	d
1971	-	d	2352	0	d	d
1972	-	0	1637	116	1753	-
1973	-	0	1542	6	1548	-
1974	-	41	470	0	511	-
1975	-	0	3200	0	3200	-
1976	2366	0	13937	2614	16551	7.00
1977	1637	4140	19442	53	23635	14.44
1978	1699	100	845	108	1053	0.62
1979	476	278	3972	149	4399	9.24
1980	3200	50	3885	104	4039	1.26
1981	18077	332	3995	0	4327	0.24
1982	22156	80	951	131	1162	0.05
1983	1176	22	5839	256	6117	5.20
1984	4130	113	5554	486	6153	1.49
1985	4366	0	7777	-	7777	1.78
1986	4179	117	-	-	-	-
1987[e]	973	-	-	-	-	-
1988	6083	-	-	-	-	-
1989	5810	-	-	-	-	-
1990	8406	-	-	-	-	-

a Tower counts of sockeye salmon prior to 1976 are unreliable indicators of escapement magnitude.

b Minor age classes are lumped with the appropriate dominant age classes for this analysis.

c Total return is estimated as the sum of the returning age classes, i.e. 1.2, 1.3, and 1.4.

d Incomplete data on cohort returns.

e Weir counts in 1987 were insufficient to estimate escapements; however, 1987 aerial, 1988 aerial, and 1988 weir data were used to estimate the escapement.

Appendix A.3. Chum salmon brood year table, Kogrukluk River, 1969-1990.

Brood Year	Number of Spawners[a]	Age of Brood Year Cohort at Time of Return 0.2	0.3	0.4	0.5	Weir Return From Each Cohort[b]	Weir Return Per Spawner
1969	-	c	c	c	c	-	-
1970	-	c	c	c	0	-	-
1971	-	c	c	5261	1419	-	-
1972	-	c	3114	5814	0	8928	-
1973	-	42	12211	25975	0	38228	-
1974	-	0	22251	571	0	22822	-
1975	-	784	3989	4512	0	9285	-
1976	8417	276	37265	49570	318	87429	10.39
1977	19444	0	7803	22839	160	30802	1.58
1978	49010	0	56423	7130	1162	64715	1.32
1979	4836	0	2079	8089	86	10254	2.12
1980	41777	38	32233	11855	388	44514	1.07
1981	57373	0	5206	4266	1411	10883	0.19
1982	79580	34	10795	12091	809	23729	0.30
1983	9407	62	3920	12072	1345	17399	1.85
1984	41484	0	29000	30401	266	59667	1.44
1985	17181	0	7802	6882	-	14684	0.85
1986	15511	0	19423	-	-	-	-
1987[d]	17422	0	-	-	-	-	-
1988	41881	-	-	-	-	-	-
1989	39548	-	-	-	-	-	-
1990	26750	-	-	-	-	-	-

a Escapements prior to 1976 were estimated from tower counts. Comparability was obtained in 1977 when both tower and weir were operated successfully.

b Dominant age classes (1.2, 1.3, 1.4) are minimally used to estimate total weir return by cohort.

c Incomplete data on cohort returns.

d Weir counts in 1987 were insufficient to estimate escapements. However, 1977 aerial, 1988 aerial, and 1988 weir data was used to estimate the weir escapement.